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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is included. (AG)

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June 1970

U.S. Training and
Employment Service
Technical Report
S-72R

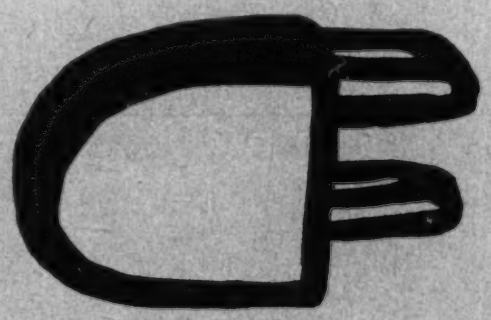
Development of USTES

APTITUDE TEST BATTERY FOR

ELECTRICIAN

(any ind.)
824.281

U S DEPARTMENT OF LABOR
Manpower Administration



Technical Report on Development of USTES Aptitude Test Battery

For . . . .

Electrician (any ind.) 824.281

S-72R

(Developed in cooperation with the
Texas State Employment Service)

U.S. Department of Labor
Manpower Administration

June 1970

FOREWORD

The United States Training and Employment Service General Aptitude Test Battery (GATB) was first published in 1947. Since that time the GATB has been included in a continuing program of research to validate the tests against success in many different occupations. Because of its extensive research base the GATB has come to be recognized as the best validated multiple aptitude test battery in existence for use in vocational guidance.

The GATB consists of 12 tests which measure 9 aptitudes: General Learning Ability, Verbal Aptitude, Numerical Aptitude, Spatial Aptitude, Form Perception, Clerical Perception, Motor Coordination, Finger Dexterity, and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, with a standard deviation of 20.

Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, in combination predict job performance. For any given occupation, cutting scores are set only for those aptitudes which contribute to the prediction of performance of the job duties of the experimental sample. It is important to recognize that another job might have the same job title but the job content might not be similar. The GATB norms described in this report are appropriate for use only for jobs with content similar to that shown in the job description included in this report.

GATB Study #834

DEVELOPMENT OF USTES APTITUDE TEST BATTERY

For

Electrician (any ind.) 824.281-014

S-72R

This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupation of Electrician (any ind.) 824.281-014. The following norms were established:

GATB Aptitudes	Minimum Acceptable GATB Scores
N - Numerical Aptitude	85
S - Spatial Aptitude	100
F - Finger Dexterity	85
M - Manual Dexterity	85

RESEARCH SUMMARY

Sample:

124 male apprentice Electricians employed in Texas. This study was conducted prior to the requirement of providing minority group information. Therefore, minority group status is unknown.

Criterion:

Broad category ratings.

Design:

Concurrent (test and criterion data were collected at approximately the same time).

Minimum aptitude requirements were determined on the basis of a job analysis and statistical analyses of aptitude mean scores, standard deviations, aptitude-criterion correlations, and selective efficiencies.

Concurrent Validity:

Phi Coefficient = .33 ($P/2 < .0005$)

Effectiveness of Norms:

Only 68% of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the above norms, 81% would have been good workers. 32% of the nontest-selected workers used for this study were poor workers; if the workers had been test-selected with the above norms, only 19% would have been poor workers.

The effectiveness of the norms is shown graphically in Table 1:

TABLE I

Effectiveness of Norms

	Without Tests	With Tests
Good Workers	68%	81%
Poor Workers	32%	19%

SAMPLE DESCRIPTION

Size:

N = 124

Occupational Status:

Apprentice Electricians

Work Setting:

The apprentices were employed in Austin and Houston, Texas. The Texas State Apprenticeship and Training Committees of the Electrical Industry made arrangements to test apprentice Electricians at various locations in Texas.

Employer Selection Requirements:

Age: None

Education: High school education preferred.

Previous Experience: None

Tests: None

Principal Activities:

The job duties of the occupation are shown in the Fact Sheet in the Appendix.

Minimum Experience:

All apprentices had at least 12 months of experience.

Means, Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion (cr) for Age, Education and Experience

	Mean	SD	Range	($_c$r)
Age (years)	23.5	4.6	17-44	-.055
Education (years)	11.9	.8	8-15	.228*
Experience (months)	28.8	13.2	12-48	..241**

* Significant at the .05 level
**Significant at the .01 level

EXPERIMENTAL TEST BATTERY

All twelve tests of the GATB, B-1001 were administered during the period of October 1953 to March 1954. The B-1001 scores have been converted to equivalent B-1002 scores.

CRITERION

The criterion consisted of ratings based on a combination of job performance and school achievement. These ratings were furnished by the Local Joint Committees and the school coordinators. The rules and regulations of the State and Local Committees require the employer and the schools to furnish monthly ratings for review at each meeting. The schools furnished attendance marks, progress records, grades and ratings on the attitude towards the job. These complete records were reviewed and combination overall ratings were used to obtain the broad category ratings. No attempt was made to treat either the data on school work or job performance separately, since the committees felt that the two measures should be combined for criterion purposes. The committees were well acquainted with every apprentice. There were 41 people in the above average group, 43 in the average group and 40 in the below average group. For computational purposes, the ratings were converted to quantitative values of 61, 50 and 39 for the above average, average, and below average groups respectively.

Criterion Dichotomy:

The criterion distribution was dichotomized into high and low groups by placing 32% of the sample into the low group to correspond with the percentage of workers considered unsatisfactory or marginal. Workers in the above average and average groups were designated as as "poor workers". The critical criterion score is 50.

APTITUDES CONSIDERED FOR INCLUSION IN THE NORMS

Aptitudes were considered for tryout in the norms on the basis of a qualitative analysis of the job duties involved and statistical analysis of test and criterion data. Aptitudes G, V, N, S, P, Q, F, and M warranted preliminary consideration for inclusion in the test norms on the basis of some qualitative or quantitative factors or both. However, the evidence to warrant consideration of aptitudes G, N, S, F, and M was found to be substantially greater than the evidence supporting the remaining aptitudes. Therefore, further consideration was confined to aptitudes G, N, S, F, and M. Tables 3, 4, and 5 show the results of the qualitative and statistical analyses.

TABLE 3

Qualitative Analysis
(Based on the job analysis, the aptitudes indicated appear to be important to the work performed)

Aptitude	Rationale
G - General Learning Ability	Required in learning and understanding the principles of electricity, reading blueprints, specifications, applicable local ordinances and the National Electrical Code in addition to knowing and practicing all safety codes.
N - Numerical Aptitude	Required in planning and taking measurements to insure that all installations to be concealed will fall within walls when they are erected later, also required in computations involved in electrical work, such as adding and subtracting whole and mixed numbers and common and decimal fractions, and applying simple algebraic and trigonometric formulas.
S - Spatial Aptitude	Required to visualize installations from blueprints and specifications and to prepare drawings in order to facilitate work.
P - Form Perception	Required to recognize sizes and types of wire devices, outlets, connectors and tools, and for recognition and interpretation of symbols in job diagrams and blueprints.
F - Finger Dexterity	Required in handling equipment and wires safely, skillfully and accurately.

M - Manual Dexterity — Required in handling equipment and tools skillfully and accurately.

TABLE 4

Means, Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($_cr$) for the Aptitudes of the GATB

Aptitudes	Mean	SD	Range	$_cr$
G - General Learning Ability	104.4	13.4	73-140	.477**
V - Verbal Aptitude	96.2	14.0	62-137	.357**
N - Numerical Aptitude	102.0	13.9	65-137	.378**
S - Spatial Aptitude	111.6	17.4	72-154	.310**
P - Form Perception	101.4	14.6	64-140	.183*
Q - Clerical Perception	92.6	11.6	70-128	.194*
K - Motor Coordination	98.0	15.2	49-147	.085
F - Finger Dexterity	102.9	14.8	56-143	.220*
M - Manual Dexterity	106.5	17.9	61-146	.025

* Significant at the .05 level
**Significant at the .01 level

TABLE 5

Summary of Qualitative and Quantitative Data

Type of Evidence	Aptitudes								
	G	V	N	S	P	Q	K	F	M
Job Analysis Data									
Important	X		X	X	X			X	X
Irrelevant									
Relatively High Mean	X			X					X
Relatively Low Standard Dev.	X	X	X			X			
Significant Correlation with Criterion	X	X	X	X	X	X		X	
Aptitudes to be Considered for Trial Norms	G		N	S				F	M

DERIVATION AND VALIDITY OF NORMS

Final norms were derived on the basis of a comparison of the degree to which trial norms consisting of various combinations of aptitudes G, N, S, F, and M at trial cutting scores were able to differentiate between the 68% of the sample considered good workers and the 32% of the sample considered poor workers. Trial cutting scores of five point intervals approximately one standard deviation below the mean are tried because this will eliminate about one-third of the sample with three-aptitude norms. For two-aptitude trial norms, minimum cutting scores of slightly more than one standard deviation below the mean will eliminate about one-third of the sample; for four-aptitude trial norms, cutting scores slightly less than one standard deviation below the mean will eliminate about one-third of the sample. The phi coefficient was used as a basis for comparing trial norms. The optimum differentiation for the occupation of Electrician (any ind.) 824.281-014 is provided by norms of N-85, S-100, F-85, and M-85. The validity of these norms is shown in Table 6 and is indicated by a phi coefficient of .30 (statistically signficant at the .0005 level).

TABLE 6

Concurrent Validity of Test Norms
N-85, S-100, F-85, and M-85

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	24	60	84
Poor Workers	26	14	40
Total	50	74	124

phi coefficient (ϕ) = .33 Chi Square (X^2_y) = 13.5
Significance level = $P/2 < .0005$

DETERMINATION OF OCCUPATIONAL APTITUDE PATTERN

The data for this study met the requirements for incorporating the occupation studied into OAP-35 which is shown in the 1970 edition of Section II of the Manual for the General Aptitude Test Battery. A phi coefficient of .28 is obtained with the OAP-35 norms of N-85, S-95, and F-80.

CHECK STUDY RESEARCH SUMMARY SHEET

S-72R GATB #834

Electrician (any ind.) 824.281-014

CHECK STUDY RESEARCH SUMMARY

Sample:

129 male journeyman Electricians employed in Austin, Houston, and Dallas, Texas.

TABLE 7

Means, Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion (cr) for Age, Education, Experience and the Aptitudes of the GATB
Cross-Validation Sample

	Mean	SD	Range	c^r
Age (years)	35.2	7.8	22- 57	-.044
Education (years)	11.4	1.7	5- 16	.115
# Experience (months)	117.6	82.8	12-408	.095
G - General Learning Ability	106.9	14.5	64-153	.324**
V - Verbal Aptitude	102.5	15.3	61-144	.222*
N - Numerical Aptitude	102.5	14.8	67-149	.301**
S - Spatial Aptitude	110.7	15.7	72-159	.260**
P - Form Perception	96.6	15.6	56-153	.192*
Q - Clerical Perception	92.1	14.2	58-152	.235**
K - Motor Coordination	93.7	17.0	46-129	.234**
F - Finger Dexterity	96.6	16.1	51-133	.148
M - Manual Dexterity	97.2	19.4	43-141	.203*

N = 128

* Significant at the .05 level
**Significant at the .01 level

Criterion: Ratings based on a combination of job performance and school achievement.

Design:

Concurrent (test and criterion data were collected at approximately the same time). The criterion data were collected in 1954.

Principal Activities:

The job duties for each worker are comparable to those shown in the job description in the Appendix.

Concurrent Validity:

Phi coefficient = .27 (P/2 $<$ .005)

Effectiveness of Norms:

Only 67% of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the S-72R norms, 81% would have been good workers. Thirty-three percent of the nontest-selected workers used for this study were poor workers, if the workers had been test-selected with S-72R norms, only 19% would have been poor workers.

TABLE 8

Effectiveness of S-72R Norms on Check Study Sample

	Without Tests	With Tests
Good Workers	67%	81%
Poor Workers	33%	19%

TABLE 9

Concurrent Validity of S-72R Norms on Check Study Sample

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	36	51	87
Poor Workers	30	12	42
Total	66	63	129

Phi coefficient (0) = .27
Significance level = P/2 $<$ .005

Chi square (X^2_y) = 9.1

June 1970 S-72R

FACT SHEET

Job Title

Electrician (any ind.) 824.281-014

Job Summary

Plans, lays out, modifies, repairs, tests and installs electric wiring, equipment, and apparatus for power, light communication, and control systems in residential and commercial buildings and industrial plants, following blueprints, manufacturer's instructions and contractor's specifications and in compliance with fire safety regulations and building codes; uses usual electrician's hand tools, various electrical testing devices, steam vulcanizers, hoisting equipment for moving heavy equipment, and soldering and welding equipment; directs and is assisted by one or more helpers.

Work Performed

Plans new or modified installations and repairs to existing systems. Studies blueprints, manufacturer's directions, and contractors specifications to determine what is to be done, adequacy of existing wiring or planned installation, and materials, equipment and time needed to complete job; prepares drawings of electrical installations to facilitate work; consults architect or general contractor pertaining to questionable items, delays, or unusual problems. Installs new and repairs existing wiring, electrical apparatus, heavy electrical machinery, control and communication equipment and systems. Exercises care to avoid unsightly, hazardous and unreliable wiring, and to maintain workmanship consistent with specifications and local electrical codes; insures that concealed wiring is installed before completion of future walls, ceilings, and flooring. Measures, cuts, bends and shapes, threads, assembles and installs, exposed, concealed, and recessed electrical raceqays, feeder and branch systems using such tools as hacksaw, pipe threaders and threading dies, hickey, brace and bit, pliers, and hydraulic benders; installs explosion proof fittings in all hazardous locations filling fittings with sealing compound to confine explosion.

Installs switchboards and panelboards: levels sills and secures to floor with anchor bolts; erects, plumbs and braces switchboard framework; installs conductor gutters and bolts gutters to wall or ceiling. Assisted by helper, pulls and cuts wires; inserts fishtape into raceqay, pushes it to other end, attaches conductor to end of fishtape and pulls conductor back through raceway by pulling on fishtape; uses mechanical power device to obtain required force for pulling large conductors.

Splices wires by stripping terminal ends of insulation, twisting, soldering, or using connecting devices. Identifies wires using bell outfit and tags ends or identifies wires by color. Removes defective wiring and parts. Connects wiring to lighting fixtures, power equipment, convenience outlets, switches, circuit breakers, and completes installations using hand tools such as pliers, screws and bolts, anchor bolts, wrenches, hammer, and screwdriver.

Uses hydraulic lifts to move and place heavy equipment and materials. Installs reactors, capacitors, rectifiers and the wiring for electrically operated equipment such as hoists, elevators, and motors. Erects steel towers to carry high voltage busses in electric power plants.

Tests continuity of circuits to insure electrical compatibility and safety of all components using standard electrical test and measuring instruments such as test lamp, telephone and battery, bell and battery, magneto, ohmmeter and oscilloscope. Tests oil in oil-insulated transformers for dielectric strength and filters out excessive moisture if oil does not meet required strength.

Effectiveness of Norms

Only 68% of the non-test-selected workers used for this study were good workers,; if the workers had been test-selected with the S-72R norms, 81% would have been good workers. Thirty-two percent of the non-test-selected workers used for this study were poor workers; if these workers had been test-selected with the S-72R norms, only 19% would have been poor workers. (Validation Sample)

Only 67% of the non-test-selected workers used for this study were good workers; if the workers had been test-selected with the S-72R norms 81% would have been good workers. Thirty-three percent of the non-test-selected workers used for this study were poor workers; if these workers had been test-selected with the S-72R norms, only 19% would have been poor workers. (Cross-Validation Sample)

Applicability S-72R Norms

The aptitude test battery is applicable to jobs which include a majority of the job duties described above.

GPO 898.722

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